



INVASIVE PLANT MANAGEMENT PROGRAM 2013 WORK PLAN

Invasive plant management in Yosemite National Park is based upon Integrated Pest Management, practical experience and the best available science. This work plan summarizes 2012 invasive plant management efforts and describes control actions proposed for 2013.

Comments are welcome. Please address comments to:

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For more information about invasive plants and their management in Yosemite, please visit:
<http://www.nps.gov/yose/naturescience/invasive-plants.htm>

INTRODUCTION

The purpose of the Invasive Plant Program (IPP) is to protect Yosemite National Park's natural and cultural resources from displacement by non-native invasive plants. Yosemite's is just over three quarters of a million acres in size, which makes surveying for and treating invasive plants logistically difficult. The threat from invasive species is growing and new invasive plant species and populations are found and treated each year. Limited operational resources for invasive plant control make it critical that treatments are efficient and effective and guided by a strategic plan.

Invasive plant management in Yosemite National Park is directed by the 2010 Invasive Plant Management Plan Update and the 2008 Invasive Plant Management Plan (2008 IPMP). Both can be found at: http://www.nps.gov/yose/parkmgmt/invasive_docs.htm

Management actions are based upon integrated pest management (IPM); elements that include prevention, inventory, prioritization, treatment, monitoring, research, education, and outreach. The IPM process includes manual, mechanical, biological, and chemical and cultural treatment methods to ensure that the most effective tools are used to protect resources, while posing the least possible impact to people and the environment.

This work plan addresses how Yosemite deals with the most serious invasive plant species. These species are prioritized for control based on the risk that they pose to natural and cultural resources. "High priority" species pose the greatest risk to Yosemite's natural and cultural resources and are treated before medium or low priority invasive species. Early detection and rapid response tactics allow populations to be efficiently controlled while they are still small, and minimizes the risk of further spread. Newly discovered invasive plant species and populations may receive elevated priority for control.

Resource managers conduct ongoing internal review with other branches in the Division of Resources Management and Science as well as other park divisions. External consultation with American Indian tribes and groups and other stakeholders during the invasive plant management process also occurs. Managers then derive an appropriate treatment strategy by location for invasive plant infestations. The treatment method for a particular locality depends on the invasive species, plant phenology (timing of plant growth, flowering, and senescence [aging]), as well as the availability of methods known to be effective and permitted under the IPMP. A range of site-specific considerations is taken into account when selecting the appropriate treatment methods. Site-specific considerations may include, but are not limited to:

| Location | Treatment |
|---|--|
| Wetland and riparian ecosystems (including the bed and banks of Wild and Scenic Rivers) | Treatment done in consultation with Branch of Wildlife Management where necessary. Most areas treated using aquatic herbicides if other methods are determined ineffective. |
| Terrestrial ecosystems | Herbicides may be used for Himalayan blackberry and other high priority species if other methods are determined ineffective. |
| Archeological sites | Control near archaeological resources conducted in consultation with the Branch of Anthropology. |
| Traditional-use areas | Control near traditional use areas carried out in consultation with American Indian tribes and groups |
| Designated wilderness | The minimum appropriate tool will be used to control invasive species. Herbicide use is allowed if it is determined to be the best tool after a minimum requirements analysis. Otherwise, manual methods are used. |
| Private in-holdings | Outreach, assistance, and treatment with landowner's permission |
| DNC land assignments | DNC is responsible for treatment of invasive plants. NPS staff will coordinate with DNC to treat high priority invasives following site-specific considerations |
| Special status plant habitat | Control near special status plant populations would be conducted in consultation with botanists in the Branch of Vegetation and Ecological Restoration during planning stages. |
| Wildlife species of concern and associated habitat | Control near habitat for species of concern will be conducted in consultation with wildlife ecologists during planning stages. |

Yosemite National Park consults with culturally associated American Indian tribes and groups to ensure there are no adverse effect on traditional cultural properties or traditional cultural use areas. Information sharing and project planning will continue in consultation with the American Indian tribes and groups throughout the planning and implementation of 2013 field season to ensure that concerns are properly addressed and that management recommendations are fully considered. Information sharing includes notifications, meetings and field visits, and this annual work plan, which outlines locations, approximate dates, and methods for invasive plant management activities proposed for the 2013 season.

SUMMARY OF 2012 WORK

PREVENTION, OUTREACH, AND EARLY DETECTION

Integrated weed management is essential to the Invasive Plant Management Plan. Yosemite focuses on four major programs: 1) Public outreach 2) Equipment inspection 3) Weed-free aggregate 4) Early detection, rapid response.

Public outreach

Invasive plant managers communicate with visitors, local communities, and other land managers. For example, the invasive plant website, <http://www.nps.gov/yose/naturescience/invasive-plants.htm>, was overhauled in 2010 and provides abundant information appropriate for both visitors and other land managers. The invasive plant crew offers consultation and treatment assistance for park inholdings and park neighbors.

Yosemite worked with invasive plant managers across the state to film a Best Management Practices (BMP) video on the prevention of invasive plants. This video supplements the *BMP for Land Manager's* booklet that Yosemite invasive plant managers contributed to as technical experts. The video and booklet is useful for land managers across the nation and can be found at <http://www.cal-ipc.org/ip/prevention/index.php>.

Volunteer program

In 2012, the number of volunteers who participated in invasive plant surveys and treatment was dramatically increased from 2011. Volunteers contributed extensively to mapping and removing invasive plants. Every volunteer received an overview of invasive plant management. Volunteers were instrumental in treating almost five canopy acres and 120 gross infested acres of bull thistle in Yosemite this year. This year, over 365 volunteers participated in over 21 volunteer groups for a total contribution of 2008 hours of work to the park.

Equipment inspection The Vegetation and Ecological Restoration Branch collaborates with the Division of Facilities Management to inspect all incoming heavy equipment. Heavy equipment is a major source of invasive plant propagules in the park. Most contractors fully comply with this program and few pieces of equipment have to be turned around each year.

In 2012, over 30 pieces of heavy equipment were inspected. These inspections remain an important and cost effective program to prevent the introduction of invasive plants.

Weed-free aggregate Non-native plants are often transported with imported sand and gravel (aggregate). To prevent invasive plants from being imported, resource managers inspect



quarries for invasive plants and work with quarry operators to treat invasive plants in their quarry. This reduces the risk of invasive plants coming into the park.

Yosemite led an interagency effort to write and produce two booklets on the implementation of a weed-free aggregate program. The two booklets direct information to the two groups collaborating in the program, land managers and quarry managers. In 2012, four prevention workshops highlighting weed-free aggregate, the BMP manual, and yellow starthistle prevention were held across the state. The final workshop was filmed and is available along with the booklets at <http://www.cal-ipc.org/ip/prevention/weedfreegravel.php>

Early detection, rapid response Resource managers work hard to ensure that new populations of invasive plants do not spread by treating infestations while they are still small. In 2012, a systematic survey was implemented to increase early detection and rapid response capacity. The survey was completed with the assistance of volunteers and was an opportunity to educate citizen scientists about invasive plants.

In 2012, sixteen invasive species were discovered that were previously unknown in the park. Additionally, a few of the highest priority species were discovered miles away from previously known populations. Most notably, yellow starthistle was discovered in Hetch Hetchy and near Crane Flat.

SPECIES TREATMENT SUMMARIES

Yellow starthistle (*Centaurea solstitialis*). Each field season begins with the program's most ambitious and challenging project—the treatment of yellow starthistle in El Portal. Some slopes in this area are steep enough to require the use of fall protection. In 2012, crews treated 7.2 canopy acres of yellow starthistle. They covered all previously known yellow starthistle infestations while expanding treatment into new infestations. Yellow starthistle's seedbank persists for two to three years. After several years of treatment, a major reduction in the El Portal starthistle density was seen starting in 2011 and continued in 2012 (Figure 3).

Himalayan and cut-leaf blackberry (*Rubus armeniacus* and *R. laciniatus*), collectively referred to as "blackberry"). In 2012, crews treated 17.1 acres of blackberry along the Merced and Tuolumne rivers. Due to the success of prior treatments, the total amount of herbicide applied to blackberry in 2012 declined (Figures 1-2), despite expanding treatments into the Merced River corridor and the Tuolumne river watershed.

Wall hawkweed (*Hieracium murorum*). Crews controlled an infestation of wall hawkweed at the Tecoya housing area in Yosemite Valley. This invasive plant was new to California in 2010 and has the potential to spread rapidly in the park.

Bull thistle (*Cirsium vulgare*). Staff and volunteers manually treated bull thistle, the most widespread high-priority species in Yosemite. Bull thistle is found in Yosemite Valley, Wawona, designated Wilderness, and in some recently burned areas. Over 120 gross infested acres were treated in 2012, and many of those acres were treated by volunteer efforts.

Spotted knapweed (*Centaurea maculosa*). Crews conducted follow up surveys in an ongoing effort to remove an invasive spotted knapweed population in Foresta. Less than 20 plants were found and handpulled in 2012, thus keeping Yosemite's most noxious and insidious non-native plant under control.

Oxeye daisy (*Leucanthemum vulgare*). In 2010, the IPP began intensive management of Oxeye daisy, an aggressive meadow invader. Crews surveyed 120 gross-infested acres in the Big Meadow burn area and treated 7.8 acres of oxeye daisy. The oxeye daisy population has decreased over time, likely because herbicide treatments have been effective.

Velvet grass and cheatgrass (*Holcus lanatus* and *Bromus tectorum*). Velvet grass infests hundreds of acres of Yosemite meadows. Cheatgrass is a major invader of the foothill woodlands and is spreading into new areas within the park. The most effective control methods are not yet known for these two high-priority species. Park staff are collaborating with the U.S. Geologic Survey (USGS) on effectiveness studies for velvet grass and cheatgrass control. The goal is to develop a management strategy by learning more about potential treatment tactics for these species.

TREATMENT EFFECTIVENESS

The trend of herbicide application

Yosemite invasive plant managers track the amount and location where herbicides are applied in the park. Figures 1 and 2 show the herbicide volume of aminopyralid and glyphosate applied within Yosemite and the El Portal Administrative area since the program began using herbicide four years ago. The primary targets are blackberry, yellow starthistle and oxeye daisy. The figures show that for both blackberry and yellow starthistle the number of gallons of herbicide increased from 2009 to 2010 and has decreased by 2012. This decrease is attributable to treatment success in prior years, and further decline is anticipated. This trend is also observed when examining the number of canopy acres treated over four years (Figure 3). Canopy acres are the combined area of the individual plants. Note the vertical axes are different on all graphs as aminopyralid is a more concentrated formulation than glyphosate. While the number of acres treated decreased from 2010 to 2012, the amount of area covered increased consistently from 2009 to 2012 (Figure 4). The gross infested acres, which includes the area between plants in an infestation, shows the amount of area covered by the crews.

Around 520 gross infested acres of invasive plants are documented in the park. Bull thistle, blackberry, and cheat grass have over 100 acres documented in the park. Around 65-75% of the known populations of bull thistle, blackberry and oxeye daisy are currently undergoing treatment. The help of volunteer crews greatly increased the number of acres of bull thistle under treatment. Almost the entire yellow star thistle population is currently undergoing treatment. Cheat grass and velvet grass are not currently being treated on large scale and account for much of the untreated acres at this point.

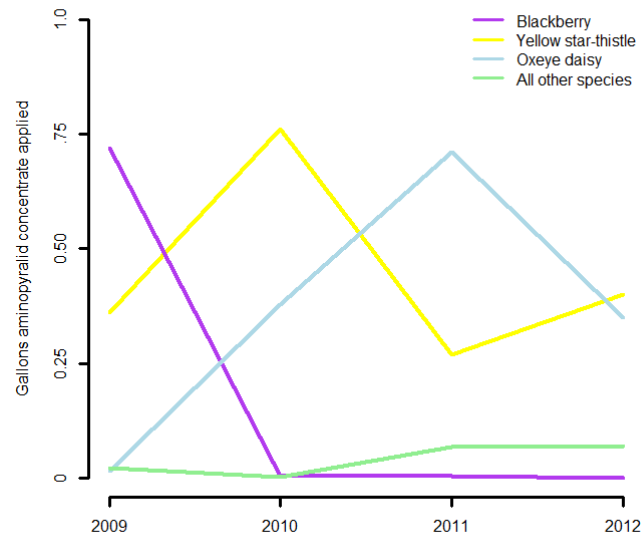


Figure 1: The number of gallons of the herbicide aminopyralid from 2009 to 2012 in Yosemite. Aminopyralid was used predominantly on yellow star thistle (yellow), and oxeye daisy (blue). The total for all species (green) also includes bull thistle and all other species treated. The amount of oxeye daisy treated doubled from 2010 to 2011 due to increased crew availability. A decrease in 2012 is attributed to successful treatments in 2011. In 2009, aminopyralid was used on Himalayan blackberry, but test plots indicated that glyphosate was more effective; hence, aminopyralid use on blackberry was discontinued.

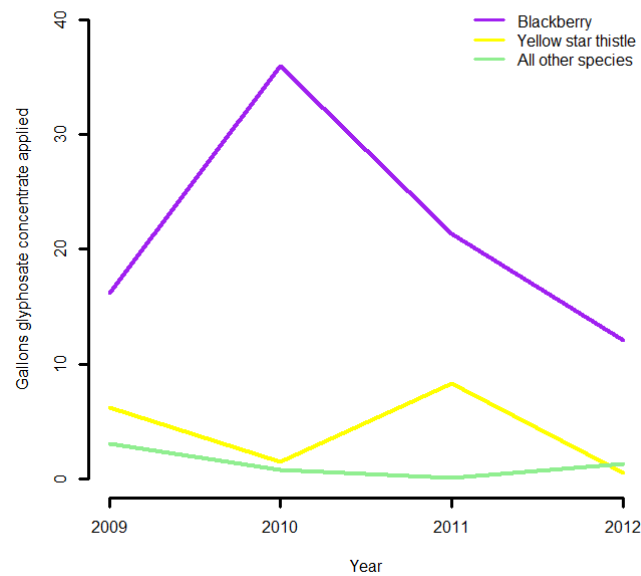


Figure 2: The number of gallons of the herbicide glyphosate from 2009 to 2012 in Yosemite. Glyphosate is used predominantly on Himalayan and cut-leaved blackberry (purple), and on yellow star thistle (yellow) in late season. The green line shows the amount used for all other species. The amount of glyphosate used on blackberry is declining while the infested area under treatment is steadily increasing. The decline in glyphosate applied is due to the treatments success attained in previous years. Many of the large patches throughout Yosemite are now in control status. For yellow starthistle, an annual plant with a large seed bank, treatments on the same acres have to be maintained for as long as the seed is viable (3-6 years).

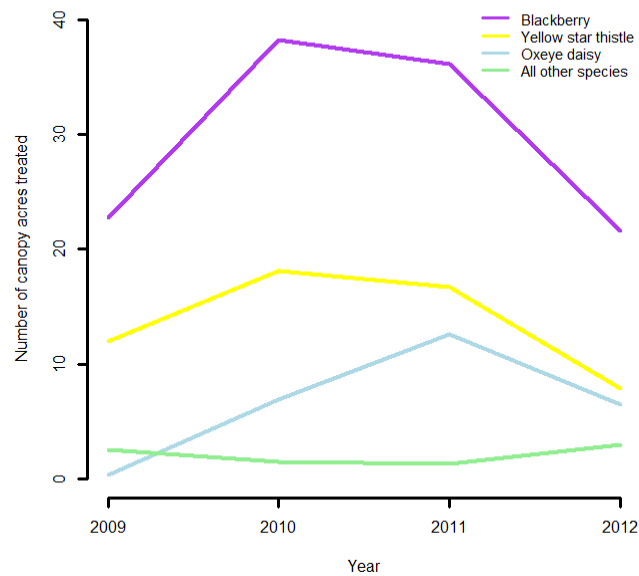


Figure 3: The number of canopy acres treated from 2009 to 2012. The increase of all species treated from 2009 to 2010 is largely due to a larger number of staff, better equipment and increase in operational efficiency. Staffing levels were similar between 2010 and 2011, and the decrease in treated acres is largely due to previous treatment success. It is anticipated that the total treated acres in 2013 will again decline based on prior year's treatment successes.

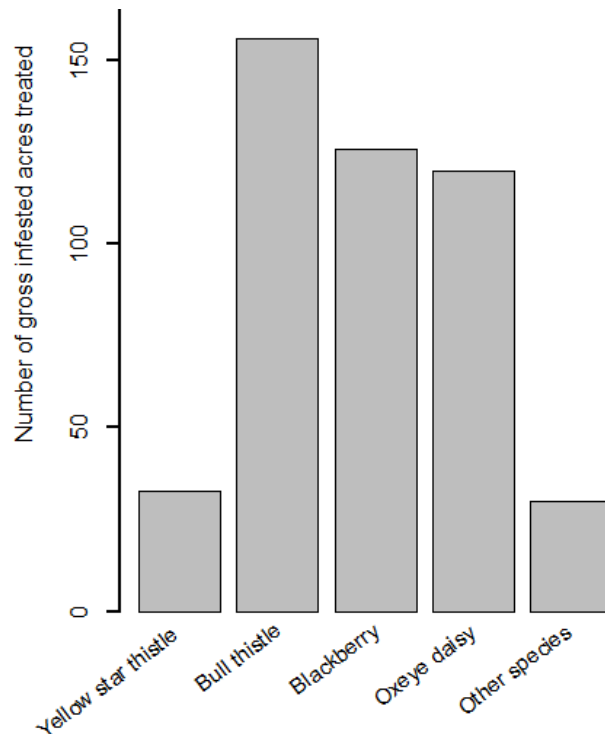


Figure 4. The number of gross infested acres treated in 2012 for yellow starthistle, bull thistle, blackberry, oxeye daisy, and all other species.

Manual treatment versus herbicide treatment of blackberry

Himalayan blackberry has been manually and mechanically treated in many easily accessible sites in Yosemite Valley. Manual and mechanical treatments involve heavy soil disturbance and major impacts to desirable native vegetation. After years of diligent re-treatment to secure treatment success, the site is often invaded by secondary invasives such as bull thistle and velvet grass. In rocky and remote terrain, it is not possible to remove blackberry roots effectively. Trial plots that compare herbicide use and hand pulling show herbicide treatments foster better and more rapid native species recovery.



Figure 5. Before (top) and after (bottom) photopoints of mechanical treatments (left) and herbicide treatments (right) on blackberry. After (bottom) photos were taken one year after treatment.

Hetch Hetchy

This year the invasive plant spray crew accessed many acres of a previously untreated blackberry population along the Tuolumne River below O'Shaughnessy Dam. This population is the uppermost well established population in the Tuolumne River drainage and acts as a seed source to downstream populations. The patch immediately below the dam required lowering a water hose over the side of the dam and carefully skirting cliffs to access several large patches. The assistance of managers at Hetch Hetchy and Law Enforcement were crucial for the successful and safe implementation of this project.

OVERVIEW OF 2013 WORK PLAN

This plan describes the methods and locations of control actions for high priority invasive species and medium-high priority species. New invasive plant species or new populations of high priority species are found each year. The most effective way to protect the park from new invasions is through rapid response to these early detections. Because of this, on a limited basis, crews may apply treatments that are not explicitly described in this document and on the maps. Some plants survive treatment, so crews will monitor previously treated sites and retreat as needed. Additionally, USGS and park scientists will continue working on an herbicide effectiveness study focused on the treatment of cheatgrass.

Detailed Planning Maps

This plan includes a set of 38 maps that provide site-specific treatment details to park staff, the public and also guide the field crews' decision-making. The maps display invasive plant infestations collected in the field since 1995. Large infestations are shown to scale as polygons. Small patches and individual plants are shown as points.

The maps have some limitations. Infestation locations are only as accurate as the equipment used to map them. For example, a patch mapped using GPS could actually be located up to 20-40 feet from where it appears. Therefore, an infestation may appear to be located in a river or middle of the road. Invasive plant infestations may have expanded or may no longer exist as shown due to effective control. Invasive species often co-occur, showing up on a map as a feature within a feature. The treated area of an infestation can overlay the larger, full infestation.

List of terms

Treatment techniques

| | |
|---------------------|--|
| Spot spray | targeted application of herbicide focused only on foliage of priority plant species using a backpack sprayer or a truck-mounted sprayer. Targeted applications reduce drift and result in minimal impact to non-target plants. |
| Frill cut | used on trees or large shrubs; a diagonal cut into the bark is made prior to herbicide application to aid delivery of herbicide into the target plant |
| Stump cut | used on trees; a tree is cut near ground level before herbicide is applied directly to the stump of the target plant |
| Hand-pull | removal of target plant biomass, including the roots, by hand |
| Lop and grub | above ground plant is cut with loppers and then the (often deeper) root system is dug out; very time intensive |
| Shovel-shear | plant is severed a couple inches under the ground surface using a shovel; some root material remains |
| Dead-head | flowers and seeds are removed to prevent spread by seed |
| Cut and dab | plants are cut a few inches from ground and herbicide is applied to the stump |

Monitoring activities

| | |
|--------------------|---|
| Survey | a systematic search for target plants |
| Grid survey | a line of people collectively search for target plants in increase survey effectiveness |
| Map | to document infestations; most often using GPS units |
| GPS | Global Positioning System; use of satellite technology to pinpoint location; used to map infestations |
| Monitor | all activities that examine results of management actions; for example, observation of a site after treatment to document outcome of that treatment |
| Pilot study | a quantitative study to assess effectiveness of a new treatment |

TREATMENT PLAN FOR HIGH-PRIORITY SPECIES

Cheat grass (*Bromus tectorum*). This plant is widespread in Yosemite and difficult to control. The IPP has not focused control efforts toward cheatgrass in the past but park scientists are continuing an herbicide effectiveness study in collaboration with USGS. Field staff and volunteers will also continue to document its distribution in the park and target some treatments to slow its spread in Wilderness.

Italian thistle (*Carduus pycnocephalus*)(photo to right). This California-listed noxious weed has been found a few times in Yosemite and effectively treated with manual methods. In 2010, populations were discovered within ¼ mile of the park borders in El Portal and Foresta. These areas will be resurveyed and treated. This plant is set to become one of Yosemite's most troublesome plants in the future.



Spotted knapweed (*Centaurea maculosa*). Since its accidental introduction to Foresta in 1990, crews have repeatedly hand-pulled spotted knapweed with the goal of eradicating it from Yosemite. Previously infested areas will be resurveyed in 2013 and individual plants will be hand-pulled or sprayed with aminopyralid. The pre-emergent properties of aminopyralid may help control late emerging individuals.

Yellow starthistle (*Centaurea solstitialis*). Extensive grid surveys have been conducted in El Portal. Manual and mechanical methods have and will continue to be used to treat small populations. Aminopyralid will be used in early season to treat most populations. Plants may be spot sprayed with glyphosate later in the season. Historic populations of yellow starthistle in Foresta will continue to be monitored. If plants are discovered, they will be hand pulled or sprayed with aminopyralid.

Bull thistle (*Cirsium vulgare*). Bull thistle is presently our most widespread, high-priority invasive plant. It is wind dispersed and quickly invades wet sites after disturbance. New infestations are often observed after prescribed and wildland fires. NPS crews remove bull thistle where encountered with aminopyralid treatment, hand-pulling or shovel-shearing.

French broom (*Genista monspessulana*). This plant was introduced to El Portal as an ornamental and is spreading quickly. Crews will treat French broom on NPS land with aminopyralid. However, it and other ornamental broom species (*Genista* and *Cytisus*) are present on in-holdings within Yosemite and some of them may be invasive. Public outreach

materials and activities are being developed to encourage cooperative resource protection between these landowners and Yosemite National Park.

Velvet grass (*Holcus lanatus*). Although velvet grass is widespread and abundant in Yosemite's meadows; the IPP does not yet have a highly effective treatment prescription. Hand-pulling can enhance the infestation by activating the robust seed bank, and initial herbicide trials did not yield promising results. New treatment prescriptions were tested through a collaborative research effort with USGS. Preliminary analysis of the results show that we have a treatment that can reduce velvet grass percent cover with a formulation of glyphosate. However, it does not appear to be a silver bullet. In 2013, small populations of velvet grass will be treated to further test the formulation. If study results indicate a viable treatment prescription, crews will begin treatment. Herbicide treatment will focus on small populations within intact native plant communities to halt further displacement of native vegetation. Additionally, small populations found along roads and trails with a high likelihood of dispersal into natural habitats will be a main target.

St. John's Wort (*Hypericum perforatum*). USFS and Mariposa County officials report St. John's wort (aka Klamathweed) is spreading quickly. St.-John's wort is very similar to the native *H. formosum*, but the native species have fewer of the characteristic translucent glandular dots when held up to the light (see photo). Infestations of St. John's wort will be treated with aminopyralid or glyphosate.



Oxeye daisy (*Leucanthemum vulgare*). Yosemite Invasive Plant managers have noted a dramatic spread in the Big Meadow area in Foresta after the 2010 Big Meadow Fire. Yosemite is continuing systematic mapping and removal operations park-wide. It is treated with aminopyralid.

Himalayan and cut-leaf blackberry (*Rubus armeniacus* and *R. laciniatus*). Himalayan blackberry constitutes the majority of invasive blackberry; cut-leaf blackberry will be treated the same as Himalayan blackberry. NPS crews will continue treatment, largely with glyphosate applied with backpack sprayers or from a truck mounted sprayer. However, imazapyr may be used from July-November, particularly on populations that have not been successfully treated with glyphosate. They will also treat with triclopyr from October-November, particularly where treatment success has been low (particularly *R. laciniatus*). Crews may cut and dab remote populations or populations located near special status plants or other special resources.

TREATMENT PLAN FOR MEDIUM-HIGH PRIORITY SPECIES

Note that species that have been underlined are a higher priority for 2013.

Tree-of-heaven (*Ailanthus altissima*). Known populations exist in El Portal and Yosemite Valley (Ansel Adams Gallery). This species is particularly difficult to control using manual and mechanical methods because it easily resprouts from remaining underground fragments. Therefore, crews will frill-cut, cut-stump, or spray foliage of small plants as appropriate. In El Portal, many plants are located near homes. Public outreach materials and activities are being developed to encourage cooperative resource protection between El Portal residents and Yosemite National Park. NPS crews will be available to help homeowners eradicate this species.

Prostrate pigweed (*Amaranthus albus*). Scattered prostrate pigweed individuals have been documented in El Portal, Wawona and Yosemite Valley. Crews may hand-pull prostrate pigweed when encountered.

Giant reed (*Arundo donax*). Although giant reed is a widespread problem in California, there is only one known population in Yosemite at El Portal. Crews treated this population with glyphosate in 2010 and 2011. This population will be monitored and retreated if necessary in 2013.

Black, field, and shortpod mustards (*Brassica nigra*, *B. rapa*, and *Hirshfeldia incana*). Several mustard species are located along roadsides. Crews will hand-pull these species as in past years and consider herbicide if populations are dense.

Tocolote (*Centaurea melitensis*) Tocolote is present from El Portal up to Foresta. Crews will treat tocolote at McCauley Ranch as NPS stock feed there. This will reduce the risk of tocolote being spread throughout the park from NPS stock.

Bermuda grass (*Cynodon dactylon*). In Yosemite Valley, Bermuda grass is only known near Ahwahnee cabins, along the roadside west of the Rangers' Club and near Stoneman Meadow. Crews will survey these locations and then the IPP will determine the best treatment options.

Foxglove (*Digitalis purpurea*). This invasive has been and will continue to be controlled by hand-pulling in Wawona, Yosemite Valley and Hodgdon. Herbicide will be considered if populations are dense.

English ivy (*Hedera helix*). English ivy is known in the park but not well documented. Field staff will map all known sites in Yosemite Valley and El Portal.

Hops (*Humulus lupulus*). Hops are present at El portal, Wawona, Carlon and several sites in Yosemite Valley. Crews treated Yosemite Valley and Carlon populations with glyphosate

in 2010 and treatments were completely ineffective. Crews will continue to test applications to remove this plant, and will likely involve a spring application of triclopyr.

Perennial sweet pea (*Lathyrus latifolius*). Perennial sweet pea (also everlasting pea) escaped cultivation and now grows in El Portal, Yosemite Valley, Wawona and Foresta. It is very difficult to control through manual or mechanical methods therefore crews will treat with aminopyralid as encountered.

Rose campion (*Lychnis coronaria*). Field staff will map known locations of rose campion and survey for new populations. If time allows, crews will treat with hand pulling and will consider herbicide for dense populations.

White sweetclover (*Melilotus alba*), yellow sweetclover and sourclover (*M. indica*). Invasive *Melilotus* populations have been documented at Hodgdon, El Portal road, Big Oak Flat Road, Hetch Hetchy (sourclover), Camp 6 (white clover), and El Portal (yellow clover). Populations will be hand-pulled as time allows.

Spearmint (*Mentha spicata* var. *spicata*). Known populations of spearmint exist in Wawona and several sites in Yosemite Valley. Populations will be mapped and monitored.

Many-flowered tobacco (*Nicotiana acuminata* var. *multiflora*). Many-flowered tobacco is found in Wawona, the Mariposa Grove and Yosemite Valley. Plants will be hand-pulled as time allows.

Virginia creeper (*Parthenocissus vitacea*). Park and volunteer crews will begin comprehensive mapping of the plant species in Yosemite as there is some evidence it is spreading from landscaped areas in Yosemite Valley. The use of this plant within Yosemite will be discouraged. Other populations are also known from El Portal. Crews will test applications to find an effective treatment (glyphosate, imazapyr, triclopyr).

Black locust (*Robinia pseudoacacia*). Yosemite Valley black locust populations are spreading and have been found as far downriver as the Rostrum. These populations were mapped and then treated using the cut-stump method. These populations will be monitored in 2013 and retreated as needed. Newly discovered populations will be treated with cut stump treatments of glyphosate or triclopyr. Basal bark applications of triclopyr will be used on small individuals.

London rocket (*Sisymbrium irio*). Field staff will map known populations of London rocket and survey for new populations.

Rose clover (*Trifolium hirtum*). Field staff will map the rose clover population above Cascades Fall (Route 140) and in Wawona.

Common mullein (*Verbascum thapsus*). This invasive plant will continue to be controlled throughout Yosemite using manual methods and spot spray chlorsulphuron in large infestations.

Purple vetch (*Vicia benghalensis*). Crews will map known locations of purple vetch and survey for new populations. If time allows, crews will treat with aminopyralid in late spring-early summer.

SPECIES WHERE POTENTIAL FOR ERADICATION IS HIGH

Table 1. Non-native species with small populations and in few locations. Eradication is highly desirable.

| Species | Location |
|--|--|
| Jointed goatgrass (<i>Aegilops cylindrical</i>) | Rancheria |
| Common ragweed (<i>Ambrosia artemisifolia</i>) | Valley Stables and Wawona Ranger Station |
| Smooth pigweed (<i>Amaranthus hybridus</i>) | Yosemite Lodge |
| Common tarweed (<i>Centromadia pungens</i>) | Henness Ridge |
| Poison hemlock (<i>Conium maculatum</i>) | Badger Pass |
| Portuguese broom (<i>Cytisus striatus</i>) | Old El Portal |
| Queen Anne's Lace (<i>Daucus carota</i>) | Rancheria |
| Mexican tea (<i>Dysphania ambrosioides</i>) | Old El Portal & Rancheria |
| Caper spurge (<i>Euphorbia lathyris</i>) | Old El Portal |
| Broadleaf helleborine (<i>Epipactis helleborine</i>) | Ahwahnee Meadow |
| Wall hawkweed (<i>Hieracium murorum</i>) | Housing, Ahwahnee Meadow |
| Roundleaf cancerwort (<i>Kickxia spuria</i>) | NPS warehouse |
| Perennial pepperweed (<i>Lepidium latifolium</i>) | Foresta |
| Hyssop loosestrife (<i>Lythrum hyssopifolia</i>) | Old El Portal |
| Dallisgrass (<i>Paspalum dilatatum</i>) | Rancheria |
| Creeping buttercup (<i>Ranunculus repens</i>) | Wawona golf course |
| Russian thistle (<i>Salsola tragus</i>) | Ahwahnee Meadow |
| Milk thistle (<i>Silybum marianum</i>) | Foresta |
| Cutleaf nightshade (<i>Solanum triflorum</i>) | Valley stables, Curry Village |
| Crimson clover (<i>Trifolium incarnatum</i>) | Old El Portal |
| Seashore vervain (<i>Verbena litoralis</i>) | Rancheria |

TREATMENT PLAN BY GENERAL LOCATION

El Portal to Pohono Bridge (Maps 1.0-1.2, and 2.0)

Crews will continue to document the presence of high priority invasive plants just as they have in the NPS residences in Rancheria, Abbeville, and the trailer court. The IPP will notify the Old EP community and will ask for permission prior to entering backyard areas.

| Species | Timing | Treatments |
|---------------------|----------------|---|
| Yellow starthistle | April-July | Spot spray (aminopyralid or glyphosate) |
| | July | Grid survey/hand-pull (based on phenology) |
| Blackberry | August-October | Spot spray (glyphosate/ triclopyr) |
| French broom | June-July | Spot spray (aminopyralid) |
| Giant reed | July | Spot spray (glyphosate) |
| Tree-of-heaven | September | Spot spray/Frill or cut stump (glyphosate/ triclopyr) |
| Hops | March-June | Test applications (triclopyr, imazapyr) |
| Perennial sweet pea | June | Spot spray (aminopyralid or glyphosate) |
| Rose clover | May-July | Spot spray (aminopyralid) |
| Tocolote | February-June | Spot spray (aminopyralid or glyphosate) |

Yellow starthistle is the greatest management concern in El Portal. The crew will survey all of El Portal and treat infestations either by manual methods or by herbicide application.

Blackberry treatment was initiated in many areas in El Portal in 2011. Treatment of remaining areas will continue in 2013. Crews will also continue to map and work with residents to remove remaining invasive species in the residential area such as **tree-of-heaven** and **French broom**. As time permits, NPS crews will also treat medium-high priority species such as **perennial sweet pea**, **yellow sweet clover**, **purple vetch**, **tocolote** and **black mustard**. Crews will survey for new populations of non-native invasive plants.

Foresta (Maps 2.0-2.2)

| Species | Timing | Treatments |
|--------------------|----------------|--|
| Spotted knapweed | June-August | Grid survey/hand-pull or spot spray (aminopyralid) |
| Yellow starthistle | May-June | Grid survey/hand-pull or spot spray (aminopyralid) |
| Blackberry | August-October | Spot spray (glyphosate/ triclopyr) |
| Velvet grass | June-July | Herbicide study (glyphosate) |
| | Spring-fall | Test timing of application (rimsulfuron) |

| | | |
|----------------------|-------------|---|
| Perennial pepperweed | June-August | Monitor |
| Perennial sweet pea | April-July | Map; spot spray (glyphosate, aminopyralid) |
| Oxeye daisy | June-August | Spot spray (aminopyralid) |
| St. John's wort | June-August | Spot spray (aminopyralid, glyphosate) |
| Cheatgrass | Feb-Oct | Pilot herbicide study (glyphosate, aminopyralid, rimsulfuron) |

NPS crews and volunteers have almost eradicated **spotted knapweed** (photo on right), **perennial pepperweed** and **yellow starthistle** from the Foresta area. Crews will continue surveying for these species and will document and hand-pull any plants encountered. Crews will remap and spray **blackberry**, most of which is at McCauley Ranch. Field staff will survey for new populations of non-native invasive plants. As in past years, crews and volunteers will hand-pull or shovel-shear **bull thistle** and spray larger populations with herbicide. They will also survey within the Big Meadow burn perimeter for **Italian thistle** and **milk thistle**. Studies in collaboration with USGS are ongoing to find effective treatments for **velvet grass** and **cheatgrass** control.



Yosemite Valley (Maps 3.0-3.9)

| Species | Timing | Treatments |
|---------------------|---------------------------------------|---|
| Blackberry | August-October | Spot spray or cut and dab in areas of sustained use such as picnic areas or lodging (glyphosate, triclopyr) |
| Velvet grass | May-July | Herbicide study (glyphosate) |
| Bull thistle | May-August | Shovel-shear, spot spray (aminopyralid) |
| Oxeye daisy | June-July | Map; spot spray with aminopyralid |
| St. John's wort | July-August | Map; spot spray with aminopyralid, glyphosate |
| Black locust | August-October | Herbicide (glyphosate, triclopyr) |
| Hops | March-June | Test applications (glyphosate, triclopyr, imazapyr) |
| Perennial sweet pea | June-July | Map new populations; spot spray with aminopyralid |
| Wall hawkweed | June-August | Retreat with aminopyralid |
| Cheatgrass | March-April ; October- December | Map; spot spray with glyphosate at select sites |

Herbicide treatment of **blackberry** and **bull thistle** in the Yosemite Valley will continue in 2013. Most populations were treated with herbicide in 2012. Most regrowth will be treated with glyphosate, but populations where eradication has been difficult will be treated with triclopyr or imazapyr. **Cheatgrass** will be treated with glyphosate along the Valley Loop Road to mitigate spread from construction activities. **Black locust** will be mapped and treated using the cut-stump method or basal bark method. Previous treatments of hops have proven to be ineffective. The spray crew will initiate herbicide application trials of **hops** to determine the most successful treatment of this species.

Wawona and Highway 41 (Maps 4.0-4.6)

| Species | Timing | Treatments |
|---------------------|----------------|--|
| Blackberry | August-October | Spot spray (glyphosate, triclopyr) |
| Velvet grass | May-July | Herbicide study (glyphosate) |
| Hops | March-June | Test applications (triclopyr, imazapyr, glyphosate) |
| St. John's wort | June-August | Spot spray (aminopyralid) |
| Bull thistle | May-August | Shovel-shear, spot spray (aminopyralid) |
| Cheatgrass | April-June | Control (glyphosate) of isolated populations (incl. Henness Ridge) |
| Foxglove | June-July | Hand-pull |
| Perennial sweet pea | June-July | Map; spot spray (aminopyralid) |
| Rose campion | May-July | Hand-pull |

The crew will treat infestations of **blackberry** with glyphosate and work cooperatively with DNC to treat the infestations near the Wawona golf course.

Velvet grass persists around the perimeter of Wawona Meadow and has a wide distribution in the area. The IPP is awaiting results of an herbicide study for effective velvet grass control. If results point to an effective treatment method, crews will treat velvet grass in key areas to reduce the risk of further spread, such as populations along the Chilnualna Falls trail and along the South Fork of the Merced River. Field staff will survey for new infestations in the newly disturbed Wawona Meadow restoration site and other areas.

Field staff will document the distribution of **cheatgrass** and remap **perennial sweet pea** and **foxglove**. To address the invasive plants on private property, the IPP will continue outreach efforts, seeking cooperation and agreements to treat plants on private land.

Cheatgrass occurs at Henness Ridge (not shown in maps) where few non-natives are present. Crews will treat cheatgrass with glyphosate or rimsulfuron during early season.

Mariposa Grove (Map 4.7)

| Species | Timing | Treatments |
|----------------|----------------|--|
| Blackberry | August-October | Spot spray (glyphosate) |
| Bull thistle | May-August | Hand-pull, shovel-shear, spot spray (aminopyralid) |
| Common mullein | May-September | Hand-pull |
| Foxglove | May-September | Hand-pull |

Invasive plant populations in the Mariposa Grove are a concern because of their potential to spread into more remote wilderness locations. Crews remapped priority species in Mariposa Grove in 2009 and treated nearly all populations. These populations were monitored and retreated in 2011/2012 and will be treated again in 2013. **Blackberry** and dense patches of **bull thistle** will be sprayed with herbicide. NPS crews and volunteers will hand-pull **common mullein** and smaller patches of **bull thistle**.

Wilderness Areas (Maps 4.5, 4.7, 5.0-5.7, 6.3, 6.4)

| Species | Timing | Treatments |
|------------------|----------------|---|
| Blackberry | June-October | Spot spray or cut-and-dab (glyphosate, triclopyr) |
| Velvet grass | June-September | Hand-pull, inflorescence removal, mow, (rimsulfuron/glyphosate) |
| Bull thistle | June-September | Hand-pull, shovel-shear or spot spray (aminopyralid) |
| Hops | March-June | Test applications (triclopyr, imazapyr) |
| Yellow salsify | June-September | Inflorescence removal |
| Common mullein | June-September | Hand-pull |
| Prickly lettuce | June-September | Hand-pull |
| Cheatgrass | June-September | Map, hand-pull |
| Common dandelion | June-September | Map, hand-pull or spot spray (aminopyralid) |

Control of invasive plant populations in designated wilderness areas is a high priority. Crews have been treating **blackberry** populations in remote locations by hand-pulling. However, where infestations are not under control with manual methods, crews will use glyphosate. If sensitive resources co-occur with the infestation, crews will employ a cut-and-dab method.

Bull thistle is the most abundant invasive species in Wilderness and has been removed manually or mechanically for decades. Crews will continue to manually treat diffuse populations, and treat large population with herbicides.

Velvet grass Park scientists are exploring options to manage large **velvet grass** infestations in Pate Valley. New methods will not be used in Wilderness until proven effective in front-country settings, but there is urgency in mitigating the threat that velvet grass poses to the wilderness.

NPS crews and volunteers will continue to manually treat several other invasive species such as **yellow salsify**, **common dandelion**, **common mullein** and **prickly lettuce** so they do not become species of priority.



HOPS GROWING UP A TREE NEAR CARLON

At the present time dandelion is a greater threat to the wilderness than previously believed, as the species is present and spreading in many locations throughout Yosemite. Fortunately the species is easily controlled with aminopyralid. This work has begun in the developed areas around Tuolumne Meadows and occasionally in wilderness. Herbicide is preferable because years of manual control efforts have not controlled this plant.

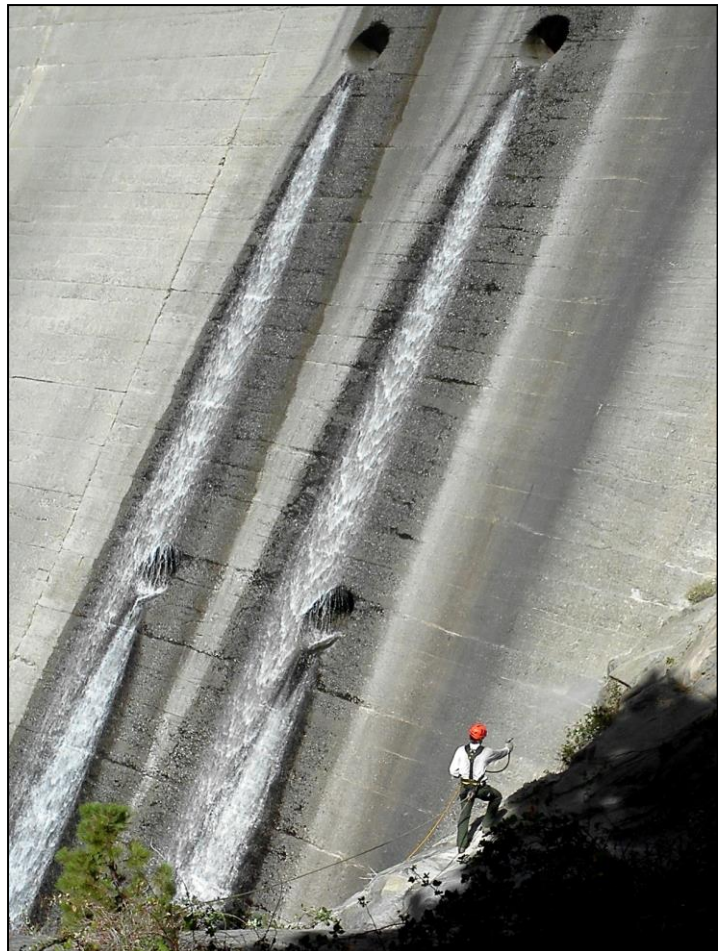
Field staff and volunteers will continue to map **cheatgrass**. Isolated populations that threaten Yosemite's pristine wilderness areas will be hand pulled. Isolated patches of cheatgrass in the wilderness may need to be treated with glyphosate, but at present we have not sufficiently appraised the status of this plant in the wilderness to inform our planning process.

O'Shaughnessy Dam to Poopenaut Valley (5.4-5.6)

| Species | Timing | Treatments |
|-----------------|----------------|--|
| Blackberry | August-October | Survey and map; herbicide (glyphosate) |
| Velvet grass | May-July | Survey and map |
| Bull thistle | April-October | Hand-pull, shovel-shear |
| St. John's wort | June-August | Spot spray (aminopyralid, glyphosate) |

Blackberry is ubiquitous along the Tuolumne River below Hetch-Hetchy, and the source population grows out of O'Shaughnessy Dam. Additional surveying will be needed to complete the mapping in the most remote sections. Treatment of the lower Tuolumne and the populations just below O'Shaughnessy Dam will be among the most difficult projects undertaken by the Yosemite invasive plant program. The large patch of blackberry grows halfway up the face of O'Shaughnessy Dam. Treatment will be difficult and require technical ropework to access. Additionally, crews have not found passage through the Poopenaut Valley. Further exploration is planned in 2013.

Crews will continue to treat the remainder of a large St. John's wort infestation along the Hetch Hetchy access road from Mather. Small, scattered populations of **bull thistle** are treated by hand-pulling and shovel-shearing. Aminopyralid will be used if large populations are discovered.



SPRAYING BLACKBERRY BELOW O'SHAUGHNESSY DAM. THE STEEP CLIFFS REQUIRE THE USE OF FALL PROTECTION TO WORK IN THIS AREA SAFELY.